Response of Lemon to Micronutrient Fertilization

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Abstract

A study was initiated in the spring of 2003 to evaluate the response of lemons to soil and foliar applied micronutrients. Soil applied Fe, Zn, Mn, and Cu was applied in sulfate form and B as Solubor in shallow holes around the skirt of each tree. Foliar applied micronutrients were all applied as "Metalosate" products. Lemon leaf tissue analyses show marginal levels of Zn, Mn, and Cu throughout the study. Occasionally soil fertilization increased leaf nutrient composition but there was no effect to foliar fertilization. Overall, there were no significant differences in yield or quality to micronutrient fertilization. This study has been continued through the 2004 season and we will report on this data when the harvest data are complete.

Introduction

Abundant information exists showing plants produced on high pH soils or soils with free lime are predisposed to micronutrient deficiencies. Because soils used for citrus production in Arizona typically have pH values ranging from 7.5 to 8.5 and free calcium carbonate, it is presumed that responses to Fe, Zn, and Mn are likely. However, we are not aware of any recent experiments in Arizona showing positive responses of citrus to micronutrient fertilization. Transitory deficiencies of Zn are seemingly periodically observed, particularly during the winter and early spring. Nevertheless, we have no data documenting tree growth reduction; yield reduction, or fruit quality losses to these transitory deficiencies. The objective of this experiment was to evaluate the response of lemons to foliar or soil applied micronutrients. Studies aimed at rates, sources, and combinations of micronutrient fertilization might follow in subsequent years depending on the results of this first study. The long-term objective is to assess to economic viability of micronutrient fertilization of desert lemons.

Materials and Methods

This field study was conducted at the Yuma Mesa Farm of the Yuma Agricultural Center on 11-year old Lisbon Lemons. This preliminary study evaluated response to single micronutrients either soil or foliar applied. The treatment design is as follows:

1. Soil Applied Fe (20 kg/ha)
2. Soil Applied Zn (20 kg/ha)
3. Soil Applied Mn (15 kg/ha)
4. Soil Applied Cu (5 kg/ha)
5. Soil Applied B (2 kg/ha)
6. Foliar Applied Fe
7. Foliar Applied Zn
8. Foliar Applied Mn
9. Foliar Applied Cu
10. Foliar Applied B

Soil applied Fe, Zn, Mn, and Cu was applied in sulfate form and B as Solubor in shallow holes around the skirt of each tree. All soil fertilization of micronutrients occurred March 17. Foliar applied micronutrients were applied as Metalosate products provided by Albion Advanced Nutrition. The rates applied each application were 40, 40, 40, 20, and 10 mL per tree for Zinc Metalosate, Manganese Metalosate, Iron Metalosate, Boron Metalosate, and Copper Metalosate, respectively. These were applied with a sprayer especially designed for research work at 4 total gallons water per tree. Foliar micronutrients were applied March 18 and April 4. The experimental design will be randomized complete block with four replications.

Leaf samples were collected in April, June, August, October, December, and February.
All leaf samples will be dried, ground and digested for analysis of N, P, K, Ca, Mg, Na, Fe, Zn, Mn, Cu, and B. Fruit yield and fruit quality was measured on all plots.

Results and Discussion

The micronutrient status of citrus leaves as affected by treatment and sampling time are shown in Figures 1 through 5. There is a lot of variation and many of the observed differences are not statistically significant. Leaf Fe levels were typically within range of levels considered adequate. There were no significant changes in leaf Fe concentration to soil or foliar applied Fe. Leaf B concentrations for most sample dates increased to soil B applications but there was no similar increase to foliar B applications. Nevertheless, all leaf B levels exceeded the critical concentration of 30 ppm and we would not anticipate a response to B fertilization.

Optimum leaf concentrations of Zn should range from 25 to 100 ppm. There was an increase in leaf Zn in June but this was temporary. We did not successfully increase leaf Zn with foliar fertilization and leaf Zn concentrations were marginal throughout the study period. Leaf Mn concentrations for some sample dates was significantly increased by soil applied Mn fertilizer but there were no significant affects to foliar Mn. Leaf Mn concentrations were near the critical level of 25 ppm for most sample dates. Leaf Cu levels were often erratic and this variation may be associated with contamination. However, Cu concentrations were generally below the critical concentration of 5 ppm and we they were not significantly increased to soil or foliar fertilization.

Overall, there were no significant differences in yield (Table 1) or quality (data not shown) to micronutrient fertilization. This study has been continued through the 2004 season and we will report on this data when the data are complete

Table 1. Results of Yields of 'Lisbon' lemons sampled in 2003.

Treatment	First Yield (lbs/tree)	Second Yield (lbs/tree)	Total Yield (lbs/tree)
Soil Fe	113.75	100.00	213.75
Soil Zn	83.75	108.75	192.50
Soil Mn	92.50	143.75	236.25
Soil Cu	75.00	113.75	188.75
Soil B	102.50	131.25	233.75
Foliar Fe	88.75	103.75	192.50
Foliar Zn	87.50	100.00	187.50
Foliar Mn	98.75	135.00	233.75
Foliar Cu	93.75	117.50	211.25
Foliar B	77.50	138.75	216.25
Stat.	NS	NS	NS

NS = not significant at the 5% level.

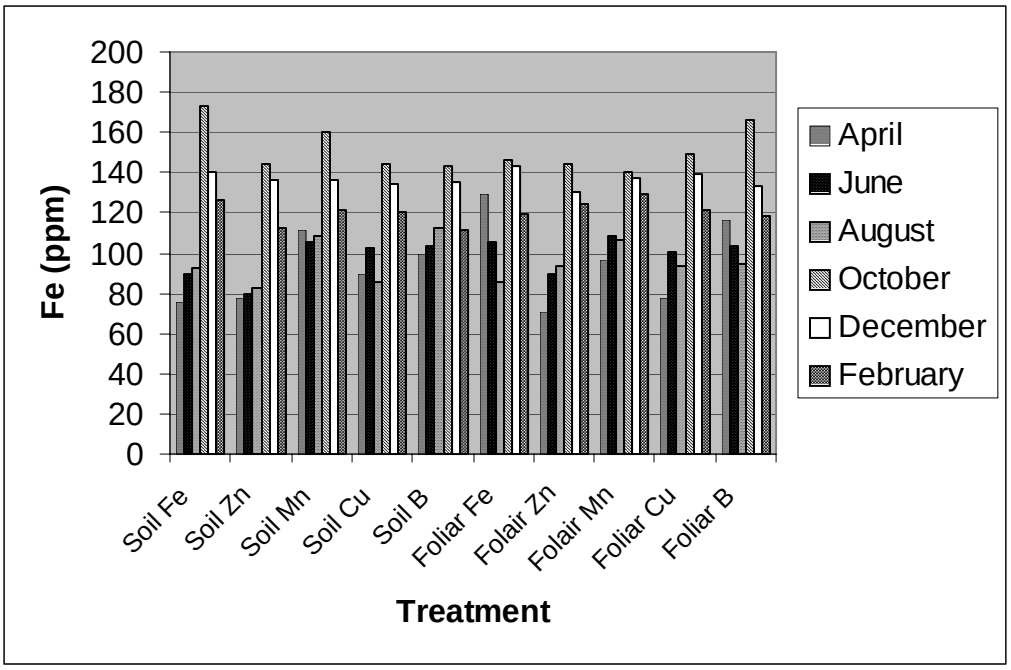

Figure 1. Iron (Fe) content (ppm) of lemons leaves to soil and foliar micronutrient fertilization.

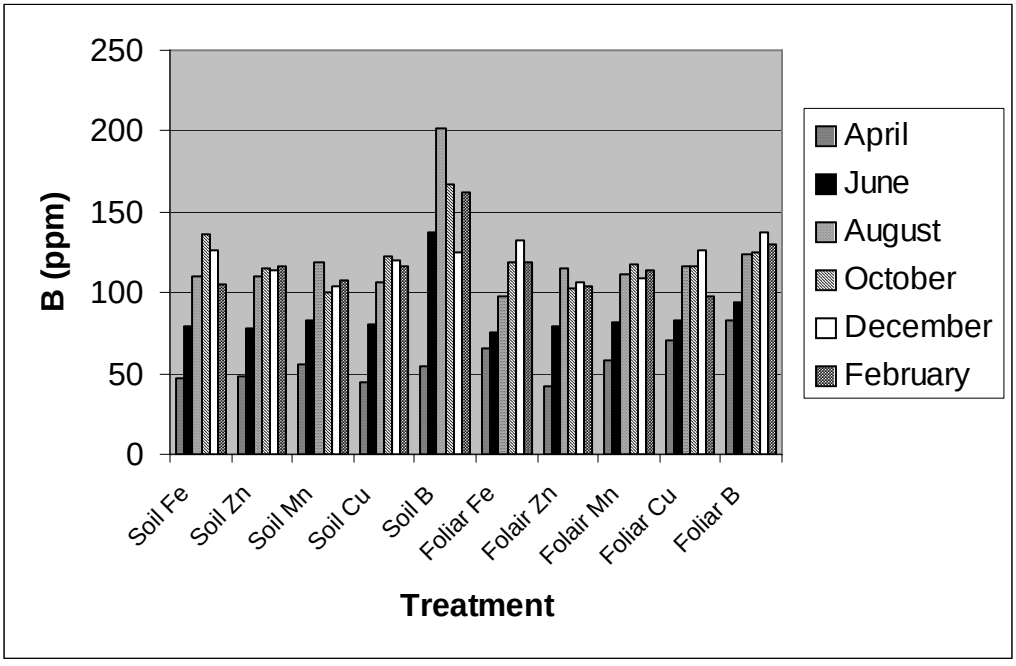

Figure 2. Boron (B) content (ppm) of lemons leaves to soil and foliar micronutrient fertilization.

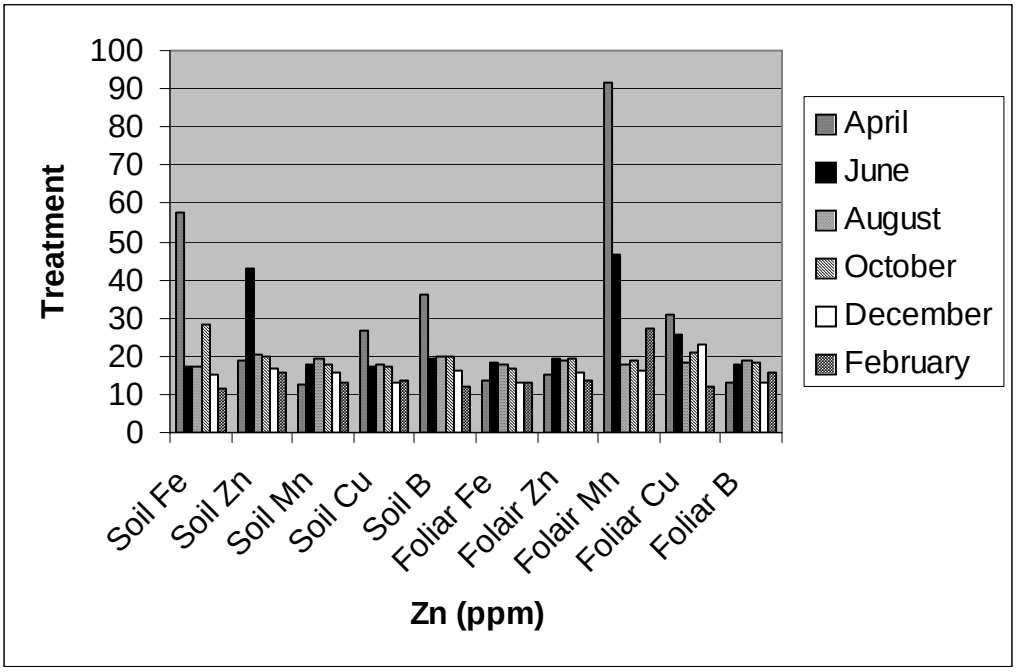

Figure 3. Zinc (Zn) content (ppm) of lemons leaves to soil and foliar micronutrient fertilization.

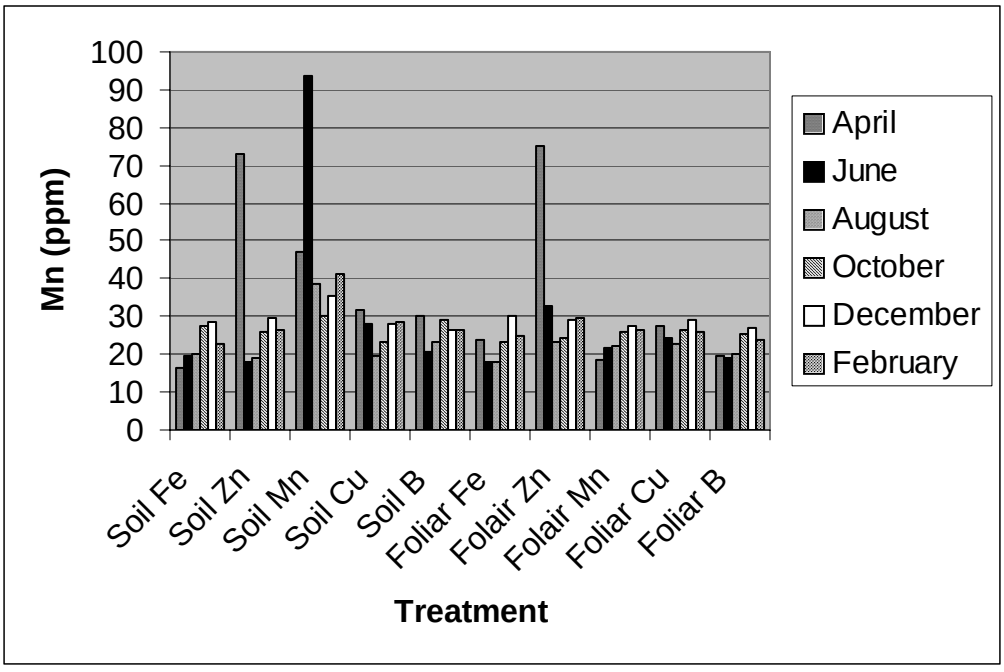

Figure 4. Manganese (Mn) content of lemons leaves to soil and foliar micronutrient fertilization.

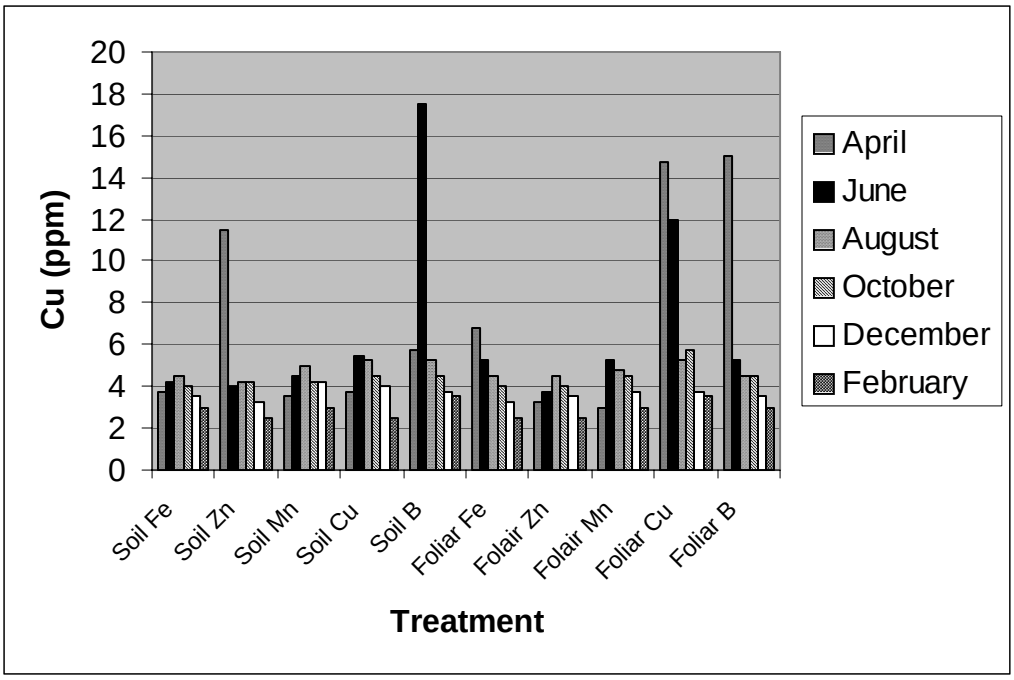

Figure 5. Copper (Cu) content of lemons leaves to soil and foliar micronutrient fertilization.